Nitrogen Sources & Pathways

Project At a Glance

Title: Nitrogen Sources and Transport Pathways: Science and Management Collaboration to Reduce Nitrogen Loads in the Great Bay Estuarine Ecosystem

Place: Great Bay, New Hampshire

Reserve: Great Bay NERR

Intended Users

- Great Bay NERR
- New Hampshire Department of Environmental Services
- Piscataqua Regional Estuaries Partnership
- Local municipalities & watershed associations

Project Team Partners

University of New Hampshire
UNH Cooperative Extension
Great Bay NERR, Piscataqua Regional Estuaries Partnership

Timeline: 10/2010 to 10/2013

Learn more

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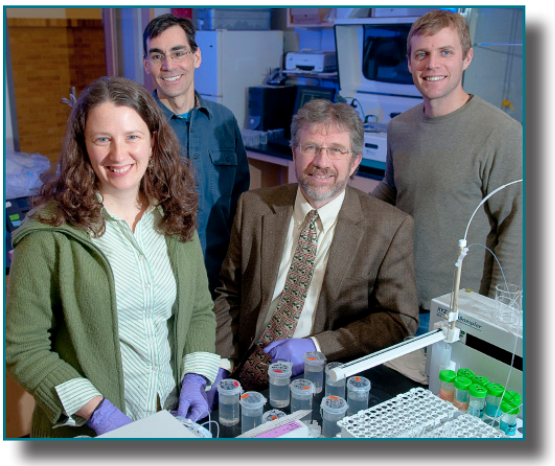
The Tipping Point

In 2009, a report came out on the health of New Hampshire's Great Bay and the news was not encouraging. The total nitrogen load to the Bay had jumped 42 percent in only five years, and the impacts were palpable. Water clarity was declining and nitrogen-fed nuisance algae populations were on the rise. Eelgrass meadows were shrinking, taking with them their capacity to stabilize sediment and provide habitat for marine life ranging from lobsters to flounder. Oxygen levels were dipping, and while they had not reached the point of hypoxia, dead zones were likely in the cards. Great Bay had reached a tipping point between healthy and collapsing ecosystems.



This project combines community engagement with field sampling and laboratory analysis to better understand the flow of nitrogen pollution through Great Bay's watershed.

Troubling? Yes. Surprising? No. The estuary cuts through the heart of the state's most recent development boom. Roughly 70 percent of the nitrogen that finds it way into the Bay comes from difuse nonpoint sources, some naturally, but a significant amount from humans through septic systems, fertilizers, impervious surface runoff, and even leaky sewer lines. Getting a handle on how nonpoint nitrogen travels through the surrounding watersheds and into Great Bay is a prerequisite for management decisions that could help heal the Bay. That's why the University of New Hampshire is working with the Great Bay NERR and other partners to map nitrogen "hot spots," understand their sources, and the capacity of Great Bay's tributary rivers to mitigte their impact.

Local Context

Stretching 15 miles inland, Great Bay is a drowned river estuary with 144 miles of shore. About 400,000 people in 49 communities live within the 930 square mile watershed that drains into the Bay. Weaving through this watershed are seven rivers that connect these communities to each other and to Great Bay. These rivers, and the streams that feed into them, play an important role in managing nonpoint source nitrogen that washes off the landscape. Historically, they have been able to treat much of the nitrogen they receive before it reaches the Bay. Yet as the amount of nitrogen flowing into these tributaries increases, their ability to cope with this pollution diminishes. How much of what kind of nitrogen would cause this sensitive dynamic to fail completely is not well understood. Until it is, local communities face a ticking time bomb that they lack the science to defuse.

The Great Bay NERR lies within the larger Great Bay watershed, encompassing more than 10,000 acres of upland forests and fields, salt marshes, mudflats, tidal creeks, rocky intertidal zones, eelgrass beds, and channel bottom. Maintaining water quality in the Bay has long been a priority of the Reserve. Staff provide data to support water quality research through System-Wide Monitoring Program (SWMP) stations and the development of habitat maps used to benchmark the impacts of land use change. They also offer practical training and education to link science with local decision makers focused on managing and improving water quality.

Sampling streams in the Great Bay watershed.

The Lamprey River, a major tributary of New Hampshire's Great Bay

Project Goals

This project team aims to address a critical gap in the scientific understanding of how nitrogen flows into Great Bay. They plan to locate nonpoint nitrogen hot spots within its watershed, identify the sources of that nitrogen, and characterize how river networks drive watershed-scale retention of nitrogen. Ultimately, they hope to provide local managers with a clear understanding of which sources of nitrogen, under which land use conditions, pose the greatest threat to Great Bay's water quality so appropriate management actions can be taken.

Approach

Collaborative

The project's integration lead is working with the Great Bay NERR Coastal Training Program to use the principles of Collaborative Learning to ensure that local decision-makers are engaged and able to provide feedback throughout the design and implementation of this research.

The project will unfold over four phases of stakeholder engagement:

- Phase 1: Watershed managers and project investigators will collectively vet the project's goal, objective, and research questions. This will take place over a series of facilitated meetings early in the project.
- Phase 2: The integration lead will convene a series of facilitated, roundtable discussions in which project investigators can present their progress and preliminary findings to policy makers, resource managers, organizational partners, and municipal decision makers and receive feedback on how these findings can be used to inform management, educational outreach, and incentives to reduce nonpoint nitrogen pollution.
- The third and fourth phases will be designed to ensure that the data and findings conveyed to stakeholders are connected to management plans, policies, and actions.

Ecology, Biogeochemistry

The project team will augment existing knowledge about the nitrogen sources in the Great Bay watershed with a deeper understanding of the role of tributary rivers and streams. Over the next three years, they will:

- Use models and field sampling to identify 250 locations that may be hot spots for inorganic nitrogen, the form directly related to human activity, the most biologically available, and mainly nitrate, in streams throughout the Great Bay watershed;
- Identify the sources of nitrate that contribute to ten or more of these hot spots using a combination of innovative methods;
- Chart nitrogen delivery pathways in these hot spots by tracking caffeine, optical brighteners, and isotopes of boron in stream water, groundwater, and stormwater runoff collected from road culverts or swales that empty into ten or more study streams;
- Evaluate how the capacity of streams and river channels to retain or reduce nitrate concentration is impacted in the ten study streams.

SUPPORT FOR THIS PROJECT

This project is being funded by the NERRS Science Collaborative.

The Science Collaborative uses a competitive process to identify and fund science to address environmental challenges in communities served by Reserves. Projects are selected through annual competitions, designed to insure that investigators, intended users of the science, and relevant stakeholders work together to describe science needs to address specific problems, define research questions, design and implement projects, and apply the results.

The program works with coastal outreach specialists, trainers, and communicators to share information about the science that it funds with other Reserves and the broader coastal management community.

The Science Collaborative also sponsors Training for the Integration of Decision-Making and Ecosystem Science (TIDES), a UNH-based program that helps develop the skills needed to link science-based information to coastal resource management decisions. TIDES offers a non-thesis master's degree track and is developing a professional certification program.

The NERRS Science Collaborative is administered by the University of New Hampshire (UNH) through a cooperative agreement with the National Oceanic and Atmospheric Administration (NOAA).

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